CLAIMS

What is claimed is:

1. A lightning protection device comprising:

a grounded central rod, wherein the central rod includes a tip mount at one end;

a conductive tip coupled to the central rod at the tip mount;

a curved conductive shell capacitively spaced from the tip and the central rod, with an annular gap between the conductive shell and the tip that functions as a spark gap; and

an electrical connection joining the conductive shell to ground;

wherein the conductive tip is one of a set of tips that may be coupled to the tip mount of the central rod, wherein the tips impart different electrical characteristics to the lightning protection device.

2. The device of claim 1, wherein the set of tips includes tips with different radii of curvature at free ends opposite ends for coupling to the tip mount, thereby changing the electrical characteristics of the device.

3. The device of claim 2, wherein at least one of the tips has a free end with a generally conical shape; wherein the protruding end protrudes from the curved conductive shell when the tip is coupled to the tip mount.

4. The device of claim 3, wherein at least another of the tips has a free end with a generally hemispherical shape.

5. The device of claim 2, wherein the set of tips includes tips with at least three different radii of curvature at respective free ends of the tips.

6. The device of claim 1, wherein the set of tips includes tips with different diameters, thereby producing annular gaps of different widths when coupled to the tip mount.

7. The device of claim 6, wherein the set of tips includes tips with at least three different diameters.

8. The device of claim 6, wherein the set of tips includes tips with different radii of curvature at free ends opposite ends for coupling to the tip mount.

9. The device of claim 8,

wherein the set of tips includes at least three tips with unique diameter-radii combinations;

wherein each of the tips has a unique radius of curvature; and

wherein each of the tips has a unique diameter.

10. The device of claim 1, wherein the electrical connection is a connection between the conductive shell and the central rod.

11. The device of claim 10, wherein the electrical connection includes a variable impedance unit.

12. The device of claim 11, wherein the impedance (resistance) of the variable impedance unit is a function of a voltage difference between the conductive shell and the central rod.

13. The device of claim 12, wherein the impedance decreases at at least one point as the voltage difference increases.

14. The device of claim 12, wherein the electrical connection includes a transorb in parallel with a resistor.

15. The device of claim 1, wherein the shell has an oblate spheroidal shape.

16. The device of claim 15, wherein the shell is an upper half of an oblate spheroid.

17. The device of claim 15, wherein the shell has a height of from about 0.25 to 0.5 times a diameter of the shell.

18. The device of claim 1, wherein the shell is a stainless steel shell.

19. The device of claim 18, wherein the stainless steel shell has a thickness of at least about 3 mm.

20. The device of claim 1, further comprising and insulating support connected to both the conductive shell and the central rod.

21. The device of claim 20, wherein the insulating support is vented.

22. A lightning protection device comprising:

a grounded central rod, wherein the central rod includes a tip mount at one end;

a conductive tip coupled to the central rod at the tip mount;

a curved conductive shell capacitively spaced from the tip and the central rod, with an annular gap between the conductive shell and the tip that functions as a spark gap; and

an electrical connection between the conductive shell and the central rod;

wherein the electrical connection includes a variable impedance unit.

23. The device of claim 22, wherein the impedance (resistance) of the variable impedance unit is a function of a voltage difference between the conductive shell and the central rod.

24. The device of claim 23, wherein the impedance decreases at at least one point as the voltage difference increases.

25. The device of claim 24, wherein the impedance decreases in a stepwise manner at at least one value of the voltage difference.

26. The device of claim 23, wherein the electrical connection includes a transorb in parallel with a resistor.

27. A method of lightning protection using a lightning protection device, comprising:

controlling electric field distribution characteristics in the vicinity of the device; and

controlling spark production characteristics of the device, wherein the controlling the spark production characteristics includes:

controlling width of a spark gap between a central grounded rod of the device and a conductive shell of the device; and

providing an electrical connection between the central grounded rod and the conductive shell.

28. The method of claim 27,

wherein the controlling the electrical field characteristics includes selecting a tip for coupling to a tip mount of the central rod, from a tip set including a plurality of tips; and

wherein at least some of the plurality of tips include tips with different radii of curvature at free ends of the tips.

29. The method of claim 27,

wherein the controlling the width of the spark gap includes selecting a tip for coupling to a tip mount of the central rod, from a tip set including a plurality of tips;

wherein at least some of the plurality of tips include tips with different diameters in central portions of the tips; and

wherein the different diameters produce different widths of the spark gap.

30. The method of claim 27,

wherein the controlling the electrical field characteristics and the controlling the width of the spark gap includes selecting a tip for coupling to a tip mount of the central rod, from a tip set including a plurality of tips;

wherein at least some of the plurality of tips include tips with different radii of curvature at free ends of the tips, wherein at least some of the plurality of tips include tips with different diameters in central portions of the tips; and

wherein the different diameters produce different widths of the spark gap.

31. The method of claim 30, wherein each of the plurality of tips has a unique combination of radius of curvature and diameter.

32. The method of claim 31, wherein the selecting the tip includes selecting a tip based on a height of a structure to which the lightning protection device is coupled.

33. The method of claim 27, wherein the providing the electrical connection includes providing a variable resistance (impedance) electrical connection.

34. The method of claim 33,

wherein the providing the variable impedance electrical connection includes providing a variable resistance electrical connection; and

wherein resistance of the variable resistance electrical connection is a non-constant function of a voltage difference between the shell and the central rod.

35. The method of claim 34, wherein the resistance decreases as the voltage difference increases.

36. The method of claim 35, wherein the resistance stepwise decreases as the voltage difference increases.